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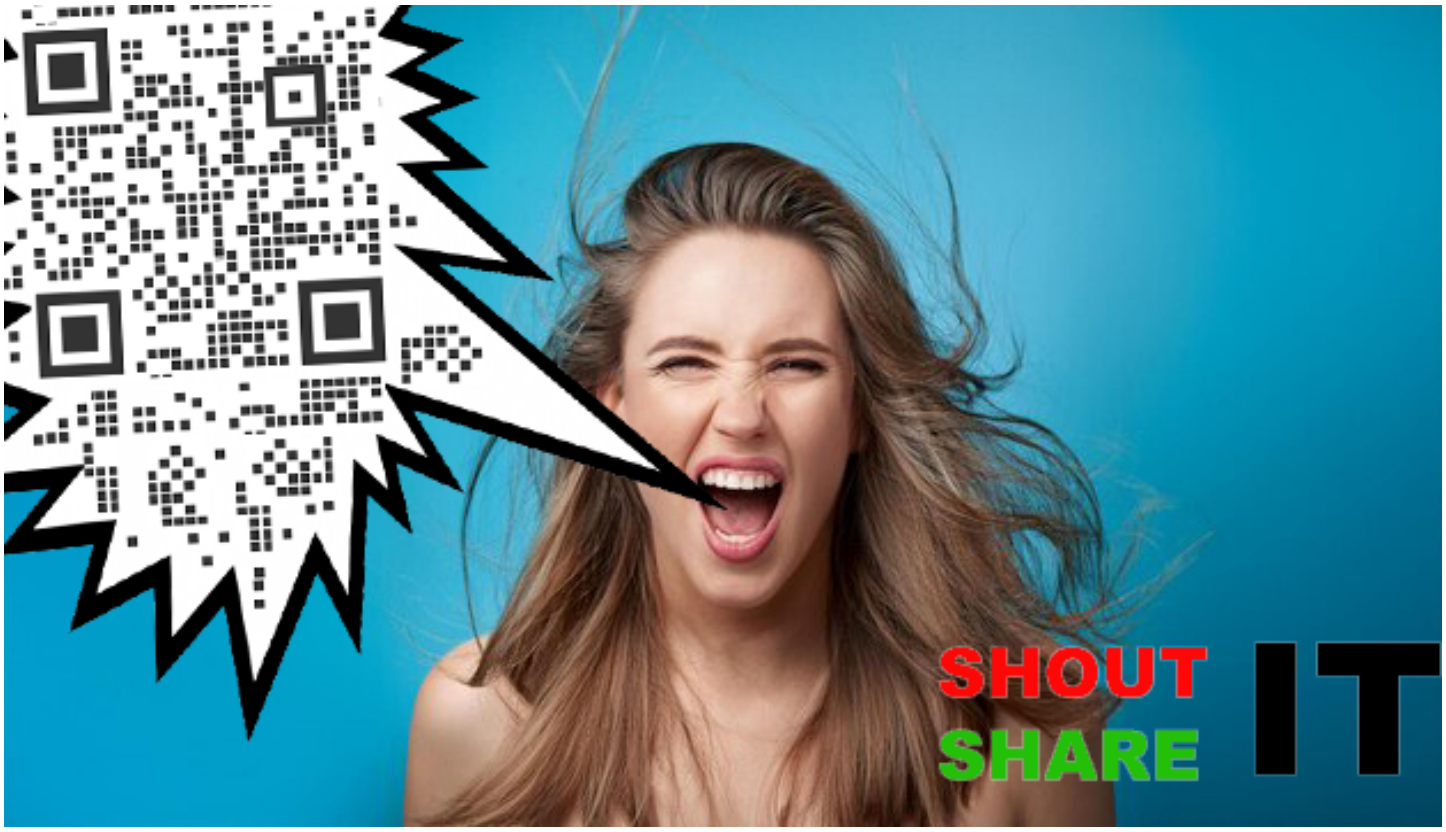
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HAWAII AGRICULTURAL EXPERIMENT STATION
HONOLULU, HAWAII
Under the joint supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE
AND THE UNIVERSITY OF HAWAII

BULLETIN No. 65

RANGE GRASSES OF HAWAII

BY

J. C. RIPPERTON, Chemist
R. A. GOFF, Extension Agent, Island of Hawaii
D. W. EDWARDS, Junior Chemist
and
W. C. DAVIS, Junior Scientific Aide

Issued June 1933

UNITED STATES DEPARTMENT OF AGRICULTURE
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[1] Retired Jan. 31, 1933.

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INTRODUCTION

During the early years of its existence, beginning in 1901, the Hawaii Agricultural Experiment Station was actively engaged in introducing various improved grasses and range plants into the Hawaiian Islands, and had the generous cooperation of the Office of Foreign Seed and Plant Introduction, now known as the Office of Foreign Plant Introduction, of the United States Department of Agriculture, which furnished numerous lots of seed of grasses and other forage crops for trial. The work was supplemented to a large extent by many local ranchmen, who placed their respective ranges at the disposal of the station for testing the introductions in comparison with the native grasses.

Nearly all of the more progressive ranchmen of the islands have introduced new species of grasses on their ranges. As a result, many improved American and European grasses are now established on the higher levels, where soil and climatic conditions more nearly approach those of the Temperate Zone than do the conditions elsewhere in Hawaii; and introductions from Africa, Australia, and India have greatly improved the grass ranges of the lower levels, particularly in the drier regions.

Shorey (*11*),[1] former chemist of the station, analyzed the more important local grasses in 1906, and found some of them deficient in lime and other mineral constituents. McClelland (*8*) in 1915 summarized the status of the early introductions. Since that time additional kinds of grasses have been introduced into the Territory, and methods of range management have undergone some changes. Dividing the range into paddocks with the resultant resting and reseeding of the grasses, and developing fattening paddocks by intensive methods of

[1] Italic numbers in parentheses refer to Literature Cited, p. 58.

culture and fertilization have been factors contributing to changes in the grass population.

This bulletin discusses the more important grasses growing on local ranges, their growth in other parts of the world, nature of growth, palatability, persistence, climatic requirements, and present importance and possibilities for Hawaii.

DESCRIPTION OF GRASSES

The grasses described were tested by the station at the University of Hawaii, Manoa Valley (100 feet elevation, 28 inches of rainfall annually), the Pensacola Street station (150 feet elevation, 40 inches of rainfall annually), the Parker ranch at Kamuela, Hawaii (2,600 feet elevation, 45 inches of rainfall annually, and cool, moist climate), and the Parker ranch at Keamoku (2,700 feet elevation, 15 inches of rainfall annually, and windy, dry climate).

For the sake of convenience each grass is treated separately. In nearly all instances the grass is pictured under actual field conditions, and a drawing is given showing the root systems, the methods of stooling or spreading, and, with some exceptions, a single flower enlarged.

Numerous grasses have more than one botanical name each. This is because changes have been made in their botanical nomenclature from time to time. The so-called synonyms should enable the reader to know readily what grass is referred to, regardless of which name is given in other publications. The botanical name first given is the preferred one. The common names by which a grass is known may be misleading. For example, nearly every district has a "bunch grass," a "bluestem grass," a "wire grass," and a "rattail grass." In another district these names may be used for entirely different species. Some of the more widely distributed grasses, such as Bermuda grass, may have a score of local names. In this bulletin only such names as are used locally or are in common use elsewhere are given.

The dates on which some of the species were introduced into Hawaii are not definitely known. Some species may have been brought in with the seed of other species, or in baled hay or imported grain. In the absence of definite information on date of introduction, the date of the first collection of the grass in the Territory is recorded in order that some approximate idea of its length of time there may be had. For the sake of brevity, all details as to source of information have been omitted from this bulletin.

No. 1. AGROSTIS ALBA *(7, p. 80)*

Common name: Redtop

Agrostis alba is found growing commonly in the eastern part of the United States, westward to Indiana and Illinois and in the southern part of Canada. It makes its best growth in wet meadows, and is not regarded as drought resistant. Redtop is perennial, and is variable in habit of growth, often attaining a height of 1 to 2 feet. Some

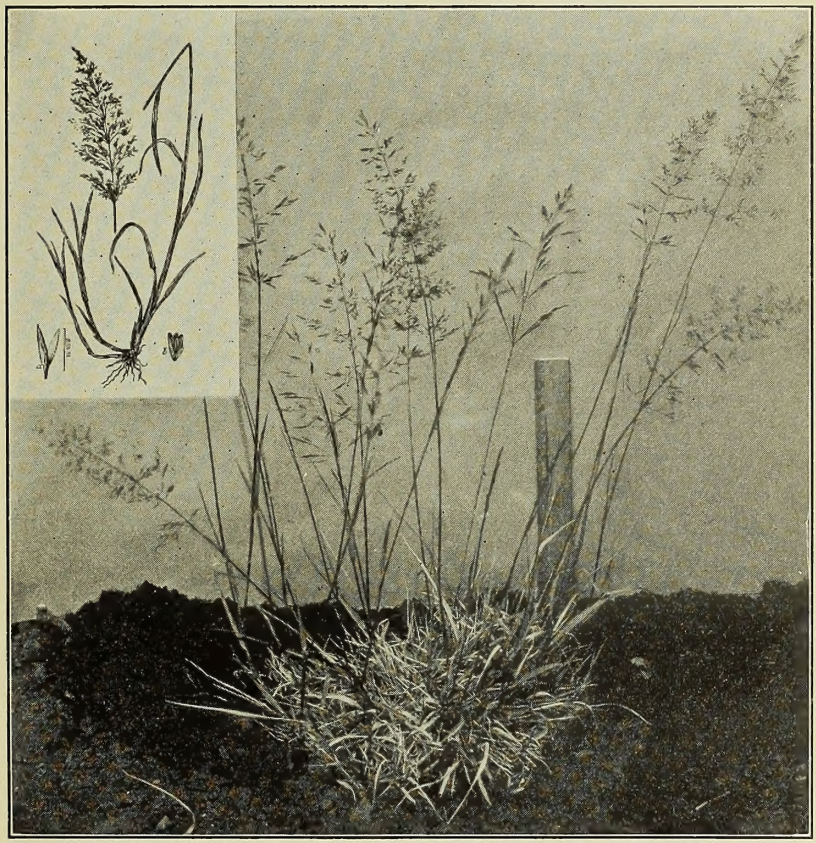

FIGURE 1.—*Agrostis alba*

varieties spread by means of creeping stems or stolons and form a uniform sod, whereas other varieties make tufted growth.

Although not widely planted, redtop is found thriving in the Glenwood and the Volcano districts of Hawaii, and on some of the higher slopes of Mauna Kea. Opinions on its value differ. In general, it is regarded as having fair grazing qualities. Used in grass mixtures, it is especially valuable on poor, thin soils. It does not crowd out other grasses and can be used until they have become established.

Because of its reddish flower clusters, this species is sometimes locally confused with Natal grass (*Tricholaena rosea*).

No. 2. ANDROPOGON ANNULATUS

Common name: Angleton grass

Angleton grass grows in India, where it is regarded as one of the best wild grasses. It is especially well suited to areas of heavy rainfall,

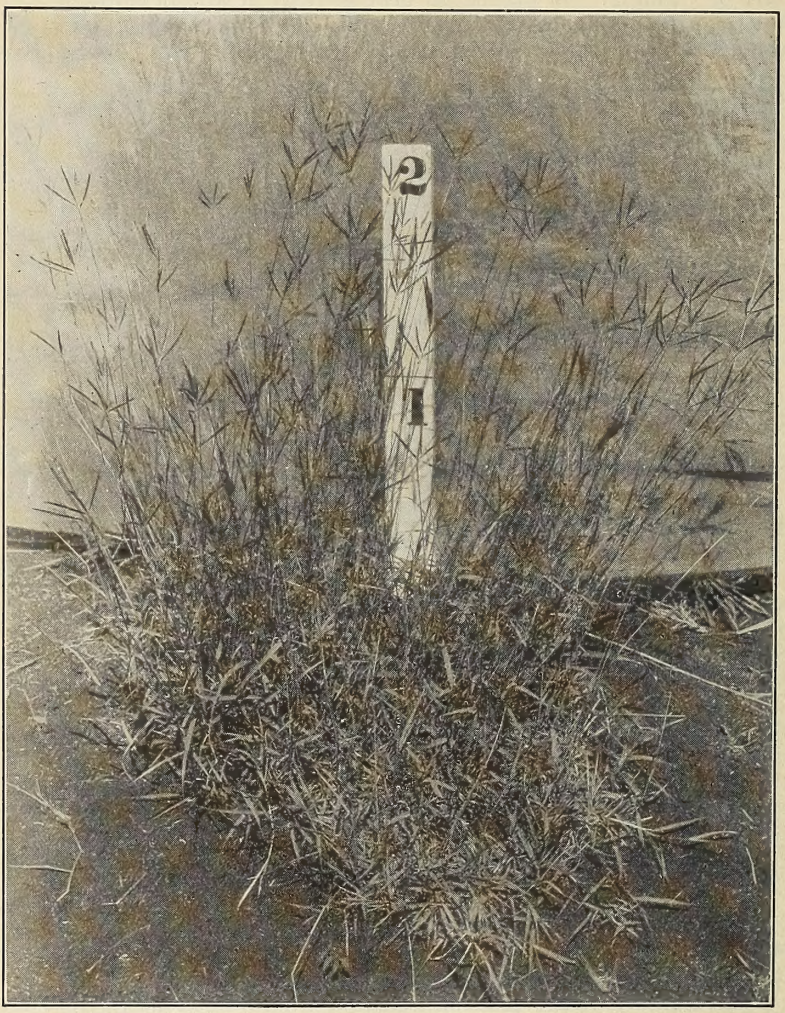

FIGURE 2.—*Andropogon annulatus*

is a perennial, and semierect, attaining a height of 5 feet or more under optimum conditions. The grass is said to be greatly relished by cattle, and is used both for pasturing and for hay. It has been grown experimentally at the station in Honolulu for a number of years, but has not been tried to any great extent on the open ranges.

No. 3. ANDROPOGON NODOSUS

Common name: Wilder grass

Wilder grass is a native of tropical Asia and has been introduced into parts of tropical America. It was introduced into Hawaii by

FIGURE 3.—*Andropogon nodosus*

G. P. Wilder and is locally known as Wilder grass (*6, p. 216*). It is perennial, semierect, and branches freely. It has grown well in experimental plantings at the Pensacola Street station in Honolulu for a number of years.

No. 4. ANDROPOGON SACCHAROIDES *(6, p. 214)*

Common names: Silver beardgrass, feather bluestem, fuzzy top

Andropogon saccharoides was found growing in the leeward parts of Molokai, Kauai, and Niihau in 1910. It is erect, attaining a height

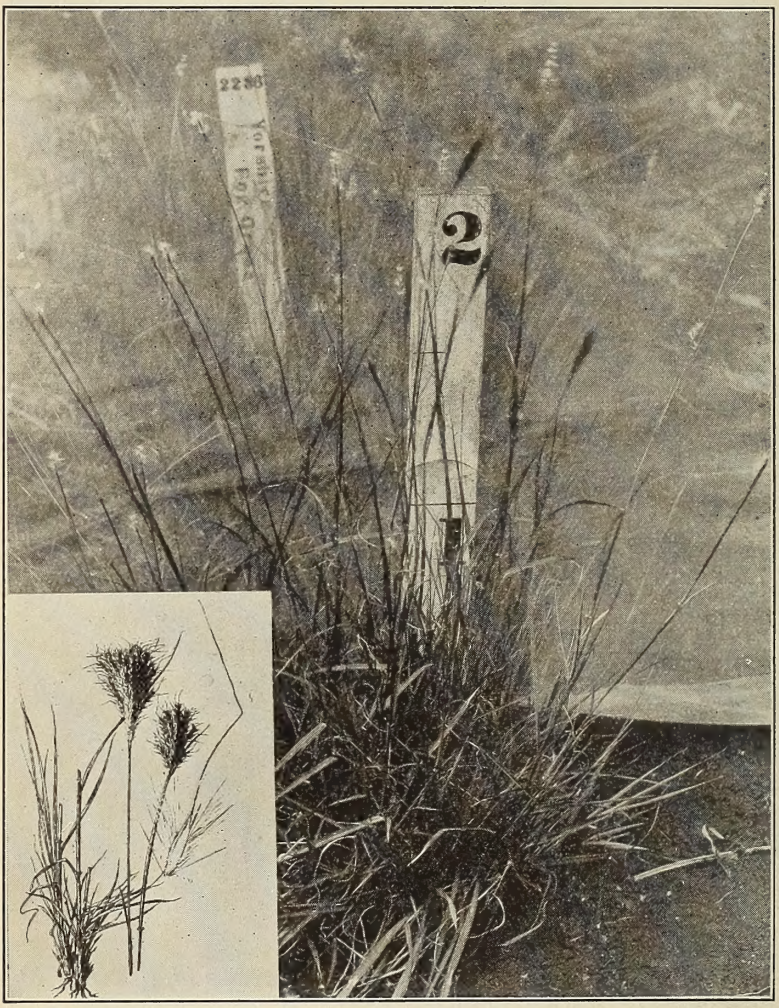

FIGURE 4.—*Andropogon saccharoides*

of 2 to 3 feet. Of no great importance at present it nevertheless offers possibilities for very dry localities.

No. 5. ANDROPOGON SERICEUS *(1, p. 204)*

Common names: Australian bluegrass, Queensland bluegrass

Australian bluegrass (*6, p. 216*) or Queensland bluegrass (*1, p. 203*) is erect or semierect and usually not more than 2 feet tall. In Hawaii it is regarded as a valuable grass for low, dry lands, particularly on

FIGURE 5.—*Andropogon sericeus*

Maui. The grass is palatable even when mature. It is hardy and will crowd out many of the undesirable grasses and weeds. Australian bluegrass thrives under such dry conditions as are suitable for cactus and will withstand a moderate amount of grazing. It should, however, be rested or reseeded at intervals. Under field conditions the segments of the head are held tightly together, giving to the whole the appearance of a solid head. When forced open the head is found to have three or more segments.

No. 6. ANTHOXANTHUM ODORATUM *(6, p. 168)*

Common name: Sweet vernal grass

A native of Europe (*6, p. 167–169*), sweet vernal grass is also found growing in the temperate regions of North America. It was collected on Molokai in 1912 and is now generally distributed over the several

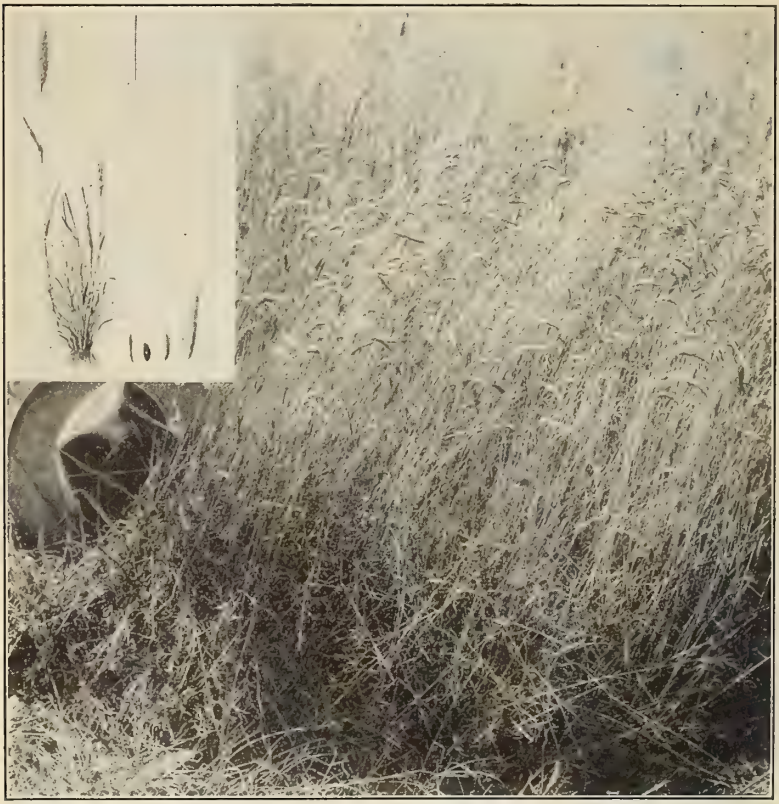

FIGURE 6.—*Anthoxanthum odoratum*

Hawaiian islands. It is perennial, erect, and attains a height of 1 to 2 feet. It thrives and seeds heavily in the higher elevations of Puu Oo and Humuulu, Hawaii. The dried grass has a pronounced sweet smell, whence its name. Livestock will not eat this grass readily, and it may prove to be a pest in uplands where it seeds heavily.

No. 7. ARRHENATHERUM ELATIUS *(6, p. 144)*

Common name: Tall oatgrass

Arrhenatherum elatius, sometimes called tall oatgrass (*3, p. 18*), is a native of Europe (*6, p. 143*). It was found growing on Lanai in 1914. It is an erect perennial, often attaining a height of 3 feet or more, and

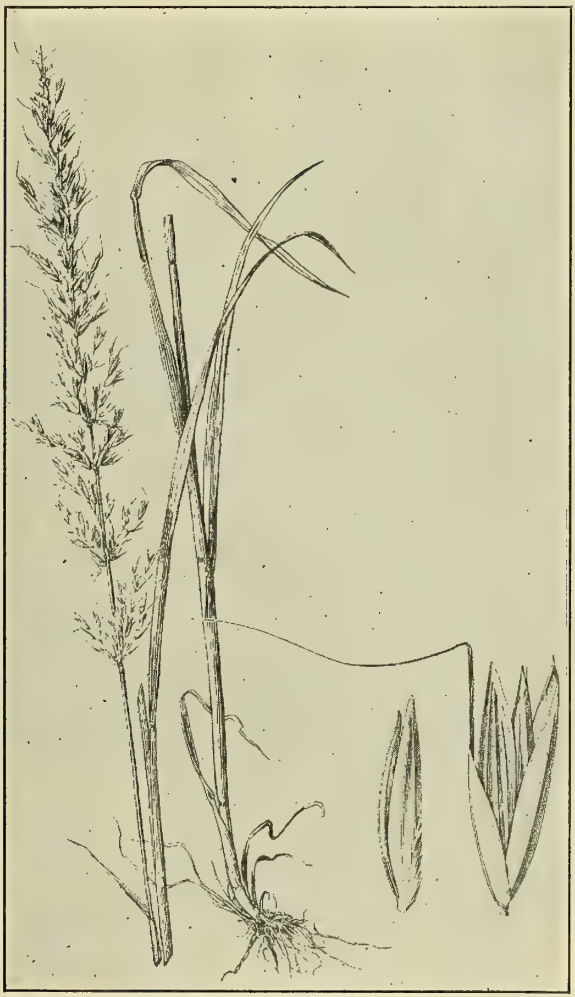

FIGURE 7.—*Arrhenatherum elatius*

is best adapted to moist regions at medium altitudes. Cattle must acquire a liking for it. Tall oatgrass stands grazing well and furnishes an abundance of feed. It has not proved to be of any great importance in the United States or in Europe. In Hawaii it is decidedly helpful in establishing a sod on thin, poor soils where desirable grasses can be grown only with difficulty.

No. 8. AXONOPUS COMPRESSUS, PASPALUM COMPRESSUM *(5, p. 224)*

Common name: Carpet grass

Carpet grass is a native of tropical America. It is of considerable importance to the stock industry of the Gulf States (*5, p. 224*), and has a wide range of adaptability to soil and moisture conditions. In Hawaii carpet grass makes its most important growth in pastures below 2,000 feet. It is a perennial, attaining a height of 5 to 10 inches, spreads by runners, and, under grazing conditions, forms a dense sod. It is among the most persistent of all Hawaiian grasses, crowding out most weeds and other grasses, and withstanding heavy and continuous grazing. It is fairly well liked by livestock, being more palatable

FIGURE 8.—*Axonopus compressus*

than Hilo grass (*Paspalum conjugatum*) and rice grass (*P. orbiculare*, but less so than Australian water grass or Dallis grass (*P. dilatatum*).

Carpet grass covers a large part of the pastures in the wet districts of Kauai, and will furnish fair pasturage, especially when sown with the sensitive plant. However, it is not liked by local ranchers because it crowds out other more nutritious grasses. It is being propagated on pahoehoe lands in the Puna district because it supersedes and smothers out the rice grass growing there. Carpet grass crowds out Hilo grass on the Parker ranch, but is not allowed to get into the paddocks where bromegrass, bur clover, and ryegrass are established. Carpet grass is encouraged in the Kona district where other grasses have not become established. Its dense, matted sod is said to aid materially in repressing the guava, an ever-encroaching pest on Kona pasture lands.

No. 9. BROMUS UNIOLOIDES *(14, pl. 85)*

Common names: Rescue grass, bromegrass, wild oatgrass

Rescue grass or bromegrass (*13, p. 32*) is found growing from Chile to the southern part of the United States, and was first reported in Hawaii in 1916. It thrives only in warm climates, is an annual, and grows to a height of 2 to 3⅓ feet. It is hardy, does well in mixtures with Bermuda grass, Kentucky bluegrass, ryegrass, and velvet grass (mesquite), and is very palatable and nutritious. Regarded as one of

FIGURE 9.—*Bromus unioloides*

the most valuable grasses on the Parker ranch it has, by self-seeding, spread for miles over the moist upper areas at elevations ranging from 2,500 to 6,000 feet. It has not been so successful on the wetter windward slopes. When first planted it should be protected from cattle until after it has seeded. It grows best where the sod has been loosened. Table 2 (p. 53) shows that two samples from the Parker ranch were exceptionally high in protein, calcium, and phosphorus. A sample from the upper part of the Kapapala ranch was of fair quality. It is strongly recommended for areas of medium altitude and moderate rainfall.

No. 10. CHLORIS GAYANA *(6, p. 166)*

Common name: Rhodes grass

Rhodes grass, a native of Africa (*6, p. 165*), was found growing in Hawaii as early as 1913. It is an erect, semibunched perennial ranging from 2 to 4½ feet in height and spreading by means of strong creeping stolons. It forms a dense sod that furnishes abundant graz-

FIGURE 10.—*Chloris gayana*

ing, and is almost the only grass used for hay in Hawaii. It withstands fairly heavy grazing if rested occasionally and is relished by all kinds of livestock, both as pasturage and as hay. As a soiling crop, it is a very heavy producer. One of its most valuable features is its ability to withstand interplanting with larger crops, such as pigeon peas and koahaole. On Hawaii it is showing up well under wet conditions similar to those at Keeau, and also under dry conditions at Kapapala,

No. 11. CHLORIS INFLATA, C. PARAGUAYENSIS *(6, p. 164)*, C. BARBATA

Chloris inflata is a native of the American Tropics. It is distributed throughout the pastures and cultivated fields of Oahu, and to a

FIGURE 11.—*Chloris inflata*

lesser extent on the other islands. It is an annual, and attains a height of 1 to 2 feet. Livestock do not relish *C. inflata*, and it is a pest both in pastures and in cultivated fields.

No. 12. CHLORIS RADIATA *(6, p. 164)*

Chloris radiata was originally described from Jamaica (*6, p. 163-165*). It is distributed throughout Central America at medium and

FIGURE 12.—*Chloris radiata*

low altitudes. In Hawaii it was found growing as early as 1895. *C. radiata* grows along the roadsides and to a limited extent in the pastures of Oahu. Together with *C. inflata* it is one of the chief pests in the alfalfa fields at Wailupe, Oahu. It is generally regarded as undesirable, although somewhat more palatable than *C. inflata.*

No. 13. CYNODON DACTYLON, CAPRIOLA DACTYLON *(6, p. 162)*

Common names: Bermuda grass, manienie

Bermuda grass is a native of the Mediterranean region (*6, p. 161*) and southern Asia, and is widely distributed over the warmer regions of both hemispheres, extending through the Tropics well up into the Temperate Zones. In Hawaii it was noted growing as early as 1895. It is perennial, and under favorable conditions attains a height of 1 foot. Bermuda grass spreads rapidly by means of runners ranging from a few inches to several feet in length. While Bermuda grass will thrive under moist conditions, it is valued in Hawaii chiefly because of its ability to grow under dry conditions where the better

FIGURE 13.—*Cynodon dactylon*

grasses fail. It does not thrive in combination with other grasses, but grows well with various clovers, such as yellow sweetclover (*Melilotus officinalis*), bur clover (*Medicago denticulata*), Japan clover (*Lespedeza striata*), and black medick (*M. lupulina*). Bermuda grass forms the foundation of most of the pastures of Molokai, Maui, Oahu, and Hawaii, from sea level to altitudes of more than 4,000 feet, except in the wetter regions where it is displaced by Hilo grass and by carpet grass. Bermuda grass is relished by cattle when it is not too old, and is of fair value for fattening. Ranchmen state that pigeon peas will thrive in a locality in which Bermuda grass makes good growth.

A giant variety of *Cynodon dactylon* has been tried at the station in Honolulu for several years and seems to have considerable merit. It spreads rapidly, produces an abundance of feed, and appears to be as palatable as the common variety.

No. 14. DACTYLIS GLOMERATA *(6, p. 136)*

Common names: Orchard grass, cocksfoot

Orchard grass, introduced into Hawaii in 1911, is an erect perennial growing in tufts or bunches, sometimes as high as 4 feet. It is restricted to altitudes of from 4,000 to 6,000 feet. Generally regarded

FIGURE 14 — *Dactylis glomerata*

as hardy, it grows well in shaded places and with many other grasses and legumes. It will not withstand close, continuous grazing, but furnishes a large amount of feed if rested occasionally. It is nutritious and palatable in its earlier stages, and in the high, dry districts is regarded as better than bromegrass. It merits more extensive trial, particularly at the higher levels.

No. 15. DIGITARIA PRURIENS, SYNTHERISMA PRURIENS *(6, p. 174)*

Common names: Crabgrass, kukaipuaa

Digitaria pruriens was collected on Oahu as early as 1895. It is distributed over all the islands up to elevations of at least 6,000 feet. It is an annual and sometimes a perennial with semierect stems, and is the most erect and vigorous of the three species of Digitaria

FIGURE 15.—*Digitaria pruriens*

common in Hawaii, often attaining a height of 3½ feet. It is distinguished from *D. violascens* and *D. sanguinalis* by the fingers of its flowering stalk, which remain unspread even when mature. This species does not grow to any extent in continuously grazed areas, but springs up readily in rested paddocks. It roots at the joints, and when not cut or grazed a single stool may spread into a clump several feet in diameter. *D. pruriens* has fair palatability.

No. 16. DIGITARIA SANGUINALIS, SYNTHERISMA SANGUINALIS *(6, p. 176)*

Common names: Crabgrass, kukaipuaa

Originally described from Europe (*6, p. 175*), *Digitaria sanguinalis* is well distributed over all the Tropics and the warmer parts of the Temperate Zones. It is annual and sometimes perennial and makes a more prostrate form of growth than does *Digitaria pruriens*. *D. san-*

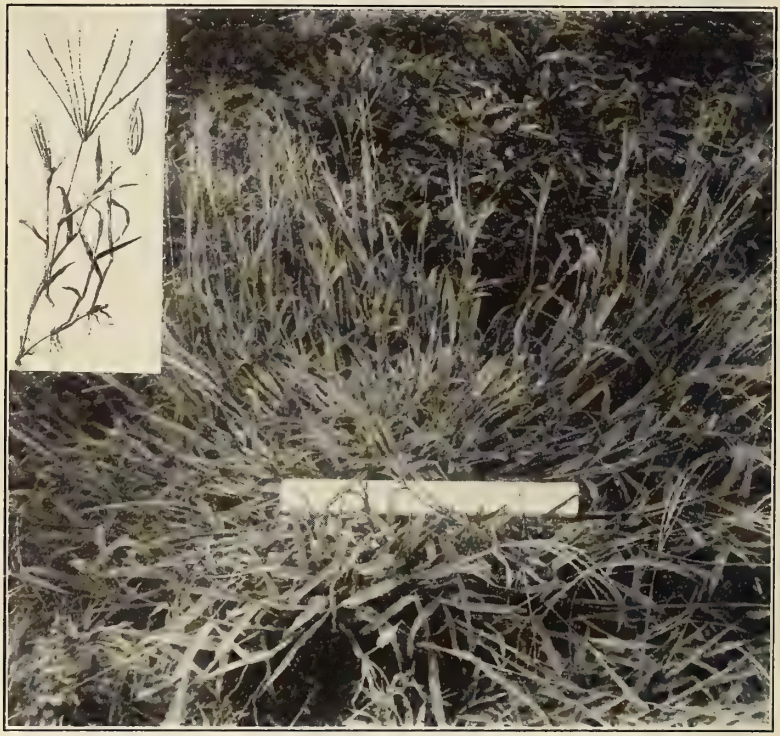

FIGURE 16.—*Digitaria sanguinalis*

guinalis roots at the nodes and under favorable conditions the prostrate stems attain a length of 3 feet or more. Under field conditions the grass is recognized by its characteristically curled, partly browned leaves, which have a dried appearance in the central part of the clump. Like *D. pruriens*, it is easily crowded out under continuous grazing, but in a rested paddock quickly reseeds itself. It is relished by all kinds of livestock and under careful management attains considerable importance. It is a common pest in cultivated fields.

No. 17. DIGITARIA VIOLASCENS, D. CHINENSIS, SYNTHERISMA CHINENSIS, S. HELLERI *(6, p. 172)*

Common names: Crabgrass, kukaipuaa

Digitaria violascens was originally described from China (*6, p. 173*). In Hawaii it is distributed over all the islands to elevations of more than 5,000 feet. It is an annual with erect or semierect stems. Locally, *Digitaria violascens*, *D. pruriens*, and *D. sanguinalis* are

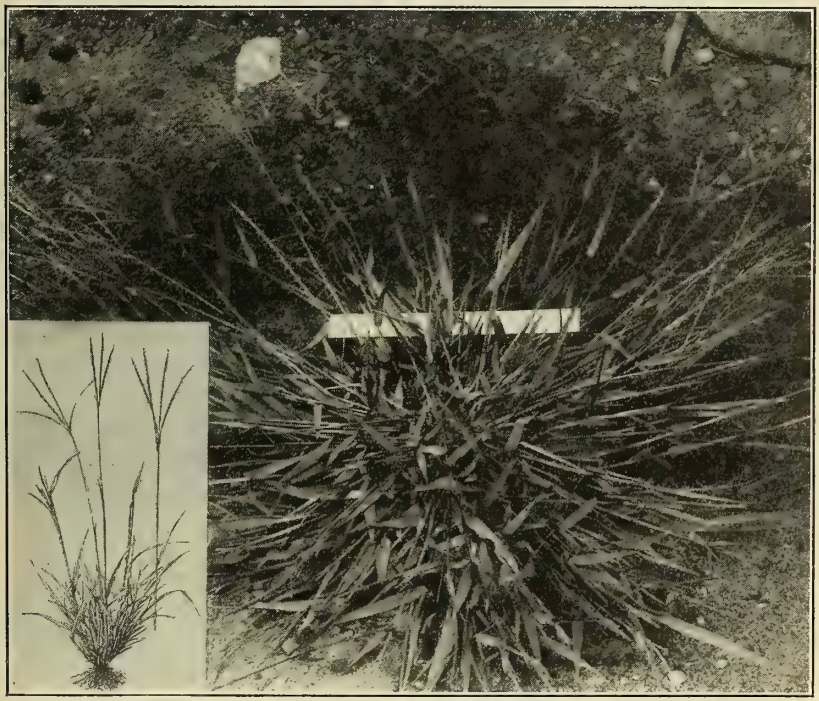

FIGURE 17.—*Digitaria violascens*

classed under the common name of "kukaipuaa." *D. violascens* differs from the other two species in that under similar conditions it is much smaller. It forms a small, dense clump and does not root at the nodes. It grows well among other grasses and withstands continuous grazing much better than do the other two species. It forms an appreciable part of the grass population on many ranches, although because of its size it is rather inconspicuous. It does well on poor soils and is very palatable.

No. 18. ELEUSINE INDICA *(6, p. 160)*

Common names: Crowfoot, goose grass or yard grass

Eleusine indica was originally described from India (*6, p. 161*), and is common to the Tropics. It was first collected on Oahu in 1902.

FIGURE 18.—*Eleusine indica*

Usually annual, but sometimes perennial, with semierect or spreading stems, yard grass is often classed as a weed. Locally, however, it is regarded as a good maintenance grass and is readily eaten by cattle and by horses when the more succulent grasses are not available.

No. 19. FESTUCA DERTONENSIS *(6, p. 112)*

Common name: Brome fescue

Brome fescue was originally described from Europe (*6, p. 116*). It was collected on Hawaii in 1909, and is now generally distributed over

FIGURE 19.—*Festuca dertonensis*

the other islands of the Territory. Usually annual but sometimes, persisting more than one season, brome fescue has fine, long, slender leaf blades. Little is known about its palatability, but observations show that it is usually closely grazed on the open ranges.

No. 20. FESTUCA ELATIOR *(14, pl. 81)*

Common names: Meadow fescue, tall fescue

Meadow fescue is found growing throughout England and continental Europe. An erect perennial, 2 to 4 feet tall, it spreads rapidly by means of creeping stems. It is said to be valuable for hay and for

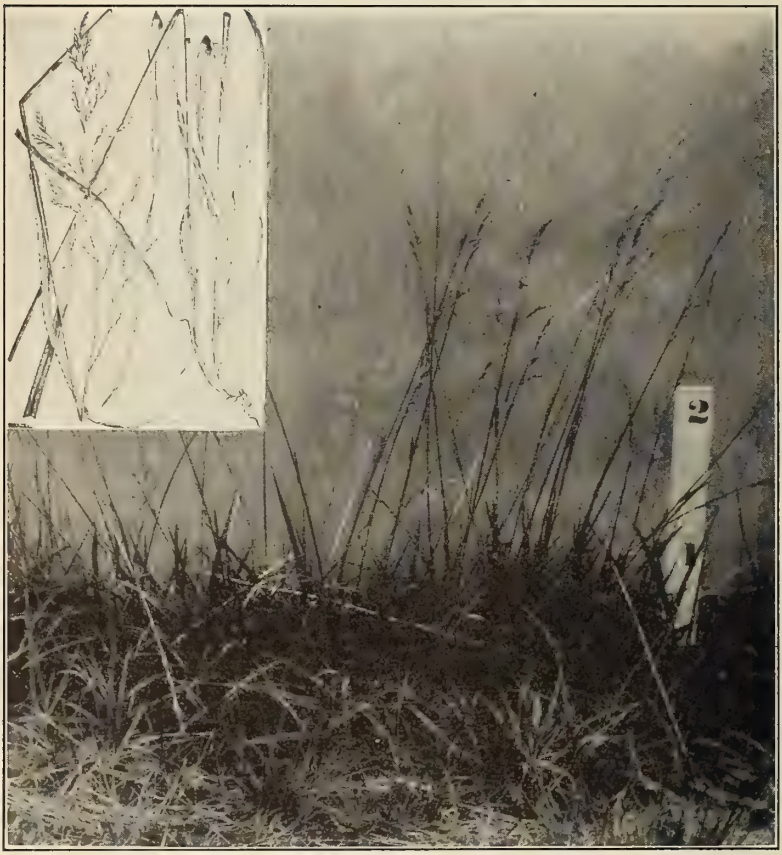

FIGURE 20.—*Festuca elatior*

pasturage, and is adapted to both dry and wet climates. In Europe it is grown in combination with ryegrass, orchard grass, timothy, and with red, white, and alsike clovers. The grazing qualities are said to be good. Meadow fescue did well in the grass garden at Waimea, Hawaii, and seems to be worthy of further trial.

No. 21. HETEROPOGON CONTORTUS *(6, p. 220)*, ANDROPOGON CONTORTUS

Common names: Pili grass, twisted beardgrass

Pili grass, a tropical perennial originally described from India (*6, p. 221*), was found growing on Kauai as early as 1895. It usually thrives best at the lower levels. It grows 20 to 40 inches tall and has a tan-

FIGURE 21.—*Heteropogon contortus*

gled, bearded head. It is very palatable when young and in the drier regions is relished by cattle even when thoroughly dry. It is frequently uprooted by cattle and will not withstand continuous grazing. It is also crowded out by such plants as Hilo grass and Bermuda grass. *Eragrostis atropioides*, also called pili grass, is a coarse grass of little value as feed, growing usually at levels above 4,000 feet and spreading by scaly, creeping underground stems.

No. 22. HOLCUS LANATUS, NOTHOLCUS LANATUS *(6, p. 146)*

Common names: Velvet grass, mesquite, Yorkshire fog

Velvet grass was originally described from Europe (*6, p. 147*). It grows in the higher regions of various parts of Europe, the United States, and Australia, and was collected on Hawaii as early as 1903. It persists under dry conditions and will withstand frosts so severe as to kill many other kinds of grass. In Hawaii it is found growing mostly above the 3,000 feet elevation on the Parker and the Puu Oo

FIGURE 22.—*Holcus lanatus*

ranches, but at the Kukaiau ranch it grows at an elevation of 2,000 feet. Velvet grass is an erect perennial 1 to 2 feet tall. Its stems and leaves are soft and velvety, and are covered with fine hairs which gather moisture from the air and thus aid the plant in withstanding drought.

There is much difference of opinion on the value of velvet grass. In Australia and in the States of Washington and Oregon it is regarded as a weed. On Hawaii, however, it is considered an excellent grass. It is a heavy yielder. Cattle fatten readily on it when it is coming into flower. It will not withstand as close grazing as will bluegrass or carpet grass.

No. 23. IXOPHORUS UNISETUS *(12, p. 4)*

Common name: Mexican grass

Mexican grass is found growing in Central America at low altitudes in wet thickets and in ditches. It was introduced into Hawaii about 1922, and grows in erect or semierect bunches, 2 to 5 feet tall. For

FIGURE 23.—*Ixophorus unisetus*

good growth Mexican grass requires an abundance of water and fertilizer, and under such conditions yields exceptionally well. It will not withstand pasturage to any extent, and on the ranch should be used chiefly as a soiling crop. Its remarkable succulence and palatability make it desirable for propagation where conditions are suitable for its maintenance. It may be propagated either by seed or vegetatively by division of the stool.

No. 24. LOLIUM MULTIFLORUM *(6, p. 138)*

Common name: Italian ryegrass

Italian ryegrass was originally described from Europe (*6, p. 141*), being a native of Italy. It was recorded in Hawaii in 1903. It is one of the oldest of the cultivated grasses and together with perennial (English) ryegrass (*Lolium perenne*) occupies an important place in European agriculture. In Hawaii the grass is considered valuable on

FIGURE 24.—*Lolium multiflorum*

the Parker and the Shipman ranches in both wet and dry districts at the higher elevations. It is an erect, short-lived perennial, 2 to 3 feet tall. It is usually grown in combination with other grasses and with clovers. It reseeds well and if allowed to rest occasionally will grow permanently on the upper areas. It is very palatable, and is nearly as valuable as bromegrass, although not so widespread. Italian ryegrass can be distinguished from English ryegrass by its awns. The two species are of practically equal value. A species known as darnel (*L. temulentum*) has also been reported as growing in Hawaii. It is poisonous and is regarded as a pest.

No. 25. MELINIS MINUTIFLORA *(9, p. 1032)*

Common names: Molasses grass, Brazilian stink grass

Molasses grass or Brazilian stink grass (*9, p. 1033*) is a native of Africa and is also found growing in South America. It was introduced into Hawaii in 1914. It has not been adopted to any great extent except on Lanai, where it thrives in the wet districts and stands

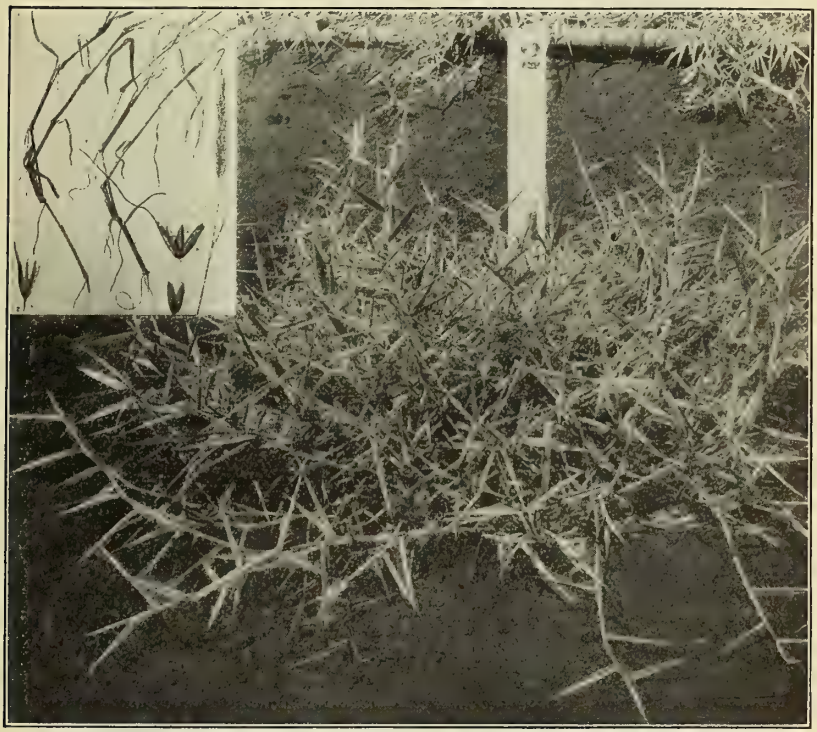

FIGURE 25.—*Melinis minutiflora*

up well during dry weather. Molasses grass is a perennial and spreads out in a mass by means of prostrate stems. Opinions as to its palatability differ greatly. Some ranchmen and dairymen regard it as palatable and nutritious, whereas others state that cattle will not eat it. This difference of opinion is due to the fact that cattle are slow to acquire a liking for it. After they acquire the taste, however, they eat the grass readily and fatten on it. Molasses grass will not withstand continuous grazing, but recovers quickly upon being rested.

No. 26. MICROLAENA STIPOIDES *(6, p. 168)*

Common names: Meadow rice grass, puu lehua

Meadow rice grass was originally described from Tasmania. It grows also in Australia, New Zealand, and the Philippines *(6, p. 167)*. In Hawaii it is found growing chiefly on the upper slopes of the Kona

FIGURE 26.—*Microlaena stipoides*

district, Hawaii. A perennial, meadow rice grass is erect or semierect, and may attain a height of 2½ feet. In Australia it is regarded as an excellent feed, a heavy yielder, and palatable. It withstands heavy grazing and is adapted to haymaking. It is said to withstand drought remarkably well, and is a good source of feed the year around. This grass would seem to deserve trial in localities other than Kona.

No. 27. ORYZOPSIS MILIACEA

Oryzopsis miliacea is found growing in China, Japan, southeastern Russia, Egypt, Arabia, and in parts of the United States. It is a

FIGURE 27.—*Oryzopsis miliacea*

Temperate Zone annual, 3 to 4 feet tall. It was introduced into Hawaii in 1918 from Florida, where it is favorably regarded. In experimental plantings in dry places on the Parker ranch at Keamoku it withstood drought well.

No. 28. PANICUM MAXIMUM *(6, p. 188)*

Common name: Guinea grass

Guinea grass, a native of Africa (*6, p. 191*), was collected on Oahu in 1903. It is an erect, tufted perennial growing 3 to 6 feet or more tall, and although primarily a soiling crop is regarded in Cuba as one

FIGURE 28.—*Panicum maximum*

of the best pasture grasses. It tillers strongly, is one of the heaviest yielding grasses, and recovers quickly after having been cut. Although harsh and coarse, guinea grass is palatable and nutritious when immature, and should be more widely grown on ranches in Hawaii for soiling purposes and for pasture in both wet and dry districts. It is being planted in the Puna district, Hawaii, and is growing well on Gouveia's ranch, Kona, where it is intercropped with koahaole (*Leucaena glauca*).

No. 29. PANICUM PURPURASCENS, P. BARBINODE *(6, p. 188)*

Common names: Para grass, panic grass

Para grass, locally known as "panicum," is a native of Africa *(6, p. 189)*, and was introduced into Hawaii from Fiji in 1902. It is essentially tropical and is generally restricted to the lower elevations. In Guam it is used for the lowland pastures. Para grass is a perennial, with semierect stems often several feet high. It spreads rapidly by means of creeping stems and is ordinarily propagated from cuttings.

FIGURE 29.—*Panicum purpurascens*

Para grass will thrive under extremely wet conditions and will also withstand severe drought. It was originally thought to be only a soiling crop, but it has been found to withstand heavy and continuous grazing. It is now used in fattening paddocks on the H. Greenwell ranch in Kona, Hawaii, the Harold Castle ranch, Oahu, and at Princeville, Kauai. Numerous dairies now cut it for use as one of their principal green feeds. It is used to a considerable extent as a green-manure crop in the local pineapple fields, is of fair palatability, and deserves a place on many Hawaiian ranches as an emergency feed during dry spells.

No. 30. PASPALUM CONJUGATUM *(6, p. 178)*

Common name: Hilo grass

Hilo grass is a native of tropical America and grows in the Tropics of both hemispheres (*6, p. 179*). It appeared in Hawaii near Hilo about 1840, and is now widely scattered over all the islands from sea

FIGURE 30.—*Paspalum conjugatum*

level to about 4,000 feet. It is a perennial, erect, 1 to 2 feet tall, and spreads rapidly by means of creeping stems. It is primarily a wet-district grass, and in such areas will grow well on poor, sour soils on which other grasses fail. Hilo grass is not well thought of where other grasses will grow. Ordinarily it is regarded as only a maintenance grass, but on rich soils it will produce good feed when kept closely grazed. It has been a good emergency crop for the Parker ranch in times of drought. In many places ranchmen are replacing Hilo grsss with the superior carpet grass.

No. 31. PASPALUM DILATATUM *(6, p. 180)*

Common names: Dallis grass, Australian water grass, paspalum grass

Paspalum dilatatum is a native of South America (*6, p. 181*). It is generally distributed throughout the Tropics and sub-Tropics of both hemispheres. It was collected in Hawaii in 1911, and is now generally scattered over all the islands, from sea level to 5,000 feet. Dallis grass is a perennial, semierect, and 1 to 3½ feet tall. It is decidedly bunching in habit of growth and spreads slowly. It is hardy,

FIGURE 31.—*Paspalum dilatatum*

thriving under wet conditions but is fairly resistant to drought. Under proper conditions it will slowly crowd out Hilo grass. It is one of the most palatable of grasses. Cattle readily fatten on it in all seasons. It withstands heavy grazing and is a valuable hay and pasture grass. Dallis grass has been widely planted on the ranches of the Territory in the last 15 or 20 years, and has proved a valuable addition to the pasture mixtures. It is not being planted extensively at present because managers feel that it spreads rather slowly and does not quickly recover after having been grazed. However, because of its excellent palatability, resistance to drought, and ability to thrive under wet conditions, it is worthy of a place on the lower levels where succulent grasses such as bluegrass, bromegrass, ryegrass, and mesquite grass do not grow readily.

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No. 32. PASPALUM FIMBRIATUM *(6, p. 174)*

Common name: Panama paspalum

Panama paspalum is found growing in Panama, the West Indies, and in the northern part of South America. It is at home in open,

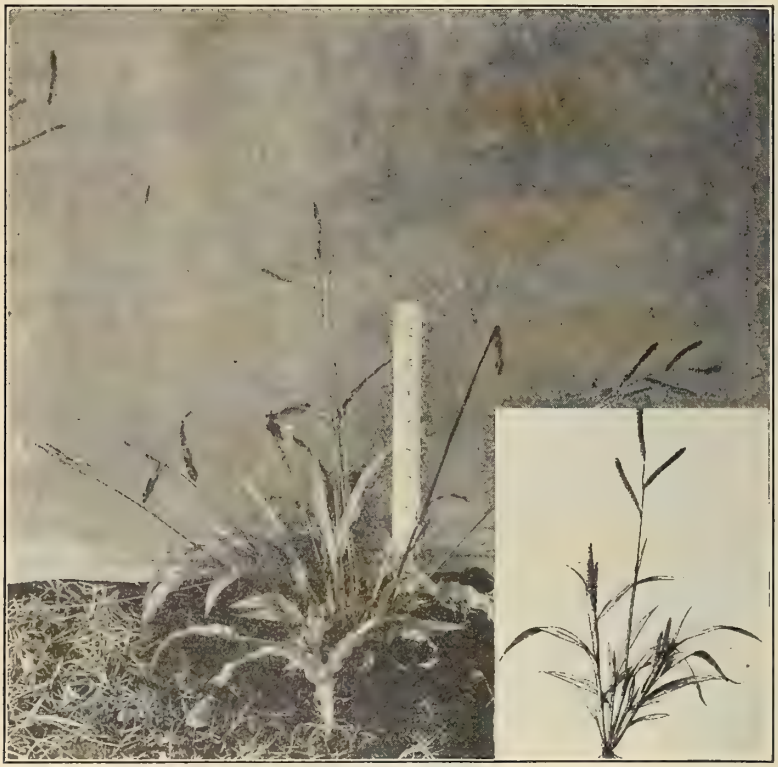

FIGURE 32.—*Paspalum fimbriatum*

waste ground, mostly in moist places. It is an annual, semierect, and 1 to 3 feet tall. In Hawaii it grows along the roadsides in numerous places on Oahu. Little is known regarding its forage value.

No. 33. PASPALUM NOTATUM

Common name: Bahia grass

Bahia grass is a native of South America and the territory northward to Mexico. It also grows in the West Indies. It is a perennial, stools rapidly, and attains a height of 1 to 2 feet. It is very hardy,

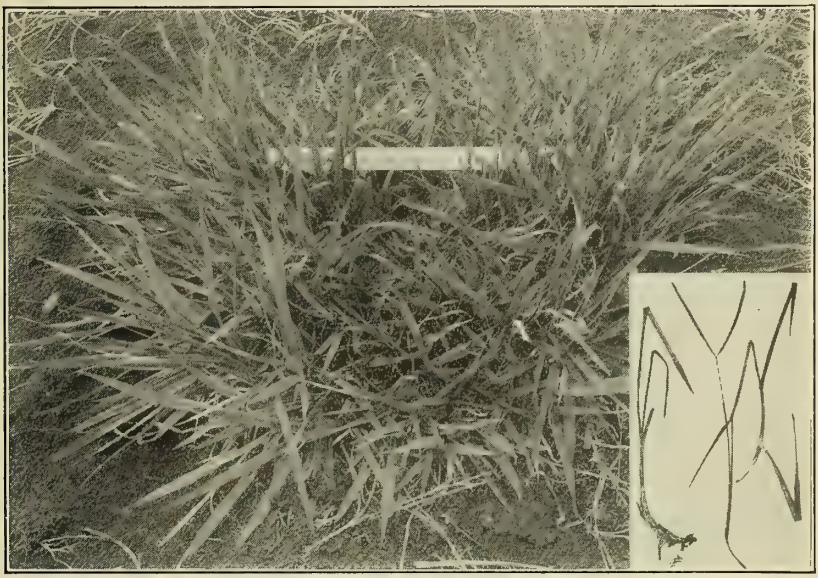

FIGURE 33.—*Paspalum notatum*

being drought resistant and likewise thriving under moist conditions. It persists at elevations ranging as high as 6,500 feet in Mexico. In Australia it withstands heavy and continuous grazing after it becomes established. It has been tried experimentally at Waimea, Hawaii, where the elevation is 2,600 feet. It grew vigorously and spread with great rapidity. Little is known about its palatability, but its vigor and rapidity of growth seem to deserve further trial.

No. 34. PASPALUM ORBICULARE *(6, p. 178)*

Common name: Rice grass

Rice grass was originally described from the Society Islands (*6, p. 179–181*), and was found growing on Oahu as early as 1895. It is perennial, erect, and attains a height of 3½ feet. It grows well where

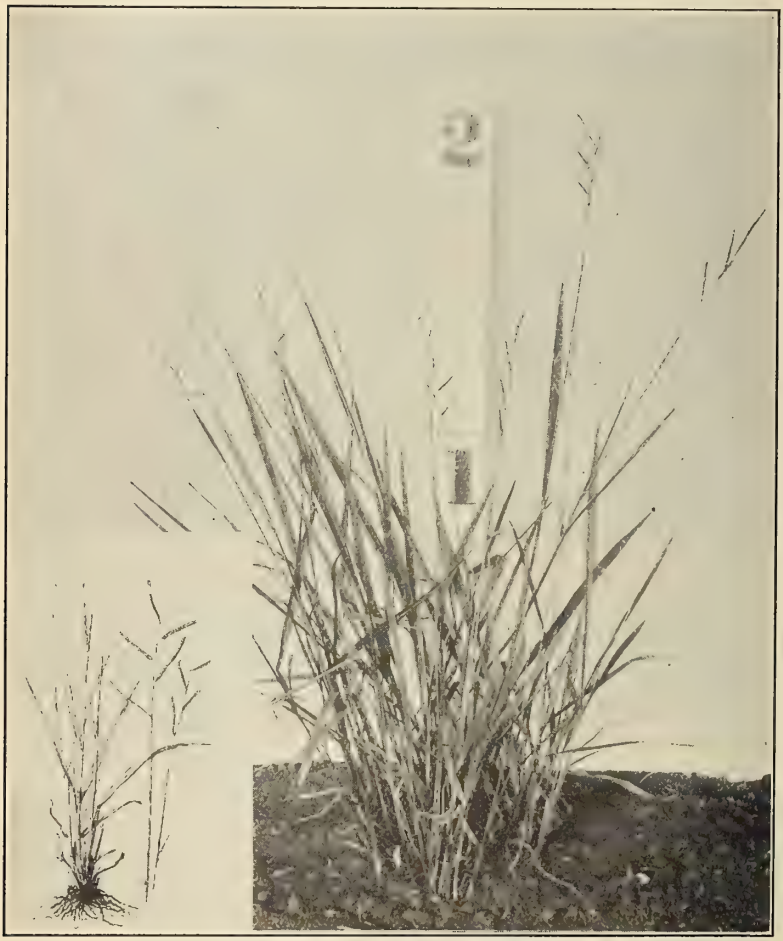

FIGURE 34.—*Paspalum orbiculare*

other grasses fail on pahoehoe lands and similar poor, thin soils. Usually it is of low feeding value. In some places the old growth of rice grass is burned off to induce new growth, which is relished by cattle. Results of a fertilizer test at Waipahoehoe, Hawaii, indicated that fertilization increases the palatability of the grass. Some ranchmen prefer it to carpet grass, but usually it is given a much lower rating than carpet grass.

No. 35. PASPALUM URVILLEI, P. LARRANAGAI *(6, p. 180)*

Common name: Vasey grass

Originally reported from Uruguay (*6, p. 181*), Vasey grass grows also in the United States from North Carolina to Texas. An erect

FIGURE 35.—*Paspalum urvillei*

perennial, Vasey grass is coarse growing, bunchy, and from 3½ to 7 feet tall. It has been grown in experimental plats at Waimea, where the elevation is 2,600 feet, and farther westward under the arid conditions of Keamoku. It did well in both places and seems to be worthy of further trial in the dry localities.

No. 36. PENNISETUM CLANDESTINUM

Common name: Kikuyu

Kikuyu grass has been tested extensively in Australia, particularly in New South Wales, and also in South Africa and east Africa (*1, p. 95*). It was introduced into Hawaii from California in 1924. It is a perennial with vigorous surface and underground runners. It sometimes grows 3 feet high on rich soil with ample moisture, but usually is 12 inches high or less. It seldom seeds in Hawaii and is propagated entirely from cuttings. It forms a sod not easily trampled out, and

FIGURE 36.—*Pennisetum clandestinum*

withstands grazing. Kikuyu grass spreads very rapidly and holds its own against practically all other grasses. In South Africa it is said to grow satisfactorily with white clover. Opinions of its palatability differ, some ranchmen stating that cattle eat it readily, others believing that stock must acquire a liking for it.

In Hawaii, the grass is being planted from sea level to 6,000 feet in elevation. It is thriving at the latter altitude, and is said not to be affected by the light frosts there. It is too early to predict the future of kikuyu grass in Hawaii, but unless it shows some undesirable feature it will be planted widely to supplant some less desirable kinds. In Australia it is being substituted for Dallis grass (*Paspalum dilatatum*) because it grows more rapidly.

No. 37. PENNISETUM COMPLANATUM *(2, p. 227)*

Pennisetum complanatum is found growing in Mexico and in Central America on the comparatively dry slopes above 6,500 feet. It is an

FIGURE 37.—*Pennisetum complanatum*

erect perennial, 2 to 6 feet tall. In Hawaii this grass, together with a closely related species, *P. setosum*, has done well under dry conditions at the Pensacola Street station in Honolulu and at Waimea, Hawaii. Little is known about the palatability of these grasses.

No. 38. PENNISETUM PURPUREUM *(10, p. 25)*

Common names: Napier grass, elephant grass

Napier grass, a native of tropical Africa (*10, p. 25*), was introduced into Hawaii about 1916. A tropical grass, it can be grown in the warmer parts of the Temperate Zones. It is best suited to moist conditions and rich soil, where it sometimes grows 12 to 14 feet high. However, it is comparatively drought resistant and makes a fair growth on poor soils. It tillers extensively, ratoons freely, and in Hawaii can be cut the year around. Like other very heavy-producing soiling crops, it imposes a heavy drain on the soil and ultimately re-

FIGURE 38.—*Pennisetum purpureum*

quires fertilization to maintain yield. Although seeding fairly well at lower altitudes, it is most easily propagated by means of cuttings. It is one of the most important soiling crops in Hawaii and it is now rather extensively planted for pasturage. For pasturing the field should be rested until the grass is about three-fourths grown. It may then be heavily stocked, has a high carrying capacity, and withstands pasturing well. It is very palatable and nutritious, and cattle come off it in prime condition. It is considered the best fattening grass for the wet districts of Maui.

Merker grass is a form of elephant grass, having a greater number of more narrow and erect leaves, and stems showing more white "bloom," and less hairy than those of Napier grass.

No. 39. PHALARIS TUBEROSA, P. BULBOSA *(1, p. 241)*

Phalaris tuberosa, a native of the Mediterranean regions of Europe (*1, p. 239*), is an erect perennial, and spreads rapidly by stooling. In other countries it is said to resist drought and frost remarkably well. In Hawaii it is an excellent grass for high, cold, wet districts, and withstands heavy grazing, particularly if lightly stocked during the first

FIGURE 39.—*Phalaris tuberosa*

year. The grass recovers quickly after it has been grazed and produces a large amount of feed. It is said to form a good mixture with white clover, and is regarded as exceptionally palatable, the equal or superior of ryegrass, cocksfoot, and Dallis grass. *Phalaris tuberosa* is recommended for trial in Hawaii at elevations above 2,500 feet.

P. stenoptera, a form of *P. tuberosa*, with a less well-developed bulbous base, and sometimes with short rhizomes, is commonly called Peruvian winter grass or Harding grass. It has been tried locally, and is to be recommended for trial.

No. 40. POA PRATENSIS *(6, p. 120)*

Common names: Kentucky bluegrass, bluegrass

Kentucky bluegrass grows throughout the Temperate Zones of both hemispheres. It grows in the Tropics at the higher altitudes. In Hawaii it is found growing as low as 2,600 feet, although its optimum growth is at 4,000 feet or higher. Kentucky bluegrass is a perennial, erect and spreading, and 1 to 2 feet tall. It forms an excellent compact turf when grazed. Primarily a rich-soil grass, it is decidedly shade-loving and hence is ideally adapted to the cool, cloudy upper slopes of

FIGURE 40—*Poa pratensis*

Hawaii. It grows well in combination with other grasses and with clovers. On the Waimea plains of the Parker ranch it persists together with Hilo grass, Dallis grass, Bermuda grass, and bromegrass, and with clovers and alfilaria. Kentucky bluegrass is one of the most palatable of grasses, and is preferred by all kinds of livestock, including dairy cattle and fattening beef animals. Under favorable conditions of soil and climate, it withstands heavy and continuous grazing and recovers rapidly after a dry period or a frost.

A related species, *Poa annua*, grows to some extent at the higher altitudes in Hawaii. It is regarded as an excellent feed in shaded and wet places. It is an annual, semierect, and 4 to 12 inches tall. *P. annua* is tufted with very fine leaves and is rather easily killed by heavy grazing, and by encroachment of perennial grasses.

No. 41. RHAPHIS ACICULATA, CHRYSOPOGON ACICULATUS, ANDROPOGON ACICULATUS
(6, p. 218)

Common name: Pilipiliula

Pilipiliula grass was originally described from the East Indies (*6, p. 219–221*). In Hawaii it occupies a considerable area on the several

FIGURE 41.—*Rhaphis aciculata*

islands. It is a perennial, 4 to 12 inches tall, and spreads by means of creeping stems that root at the joints. It is said to be able to crowd out Bermuda grass, but in turn can be displaced by carpet grass. Cattle eat pilipiliula grass sparingly, and nearly all ranchmen regard it as undesirable.

No. 42. SACCIOLEPIS CONTRACTA *(6, p. 198)*

Common name: Glenwood grass

Glenwood grass, originally described from the East Indies (*6, p. 199*), grows in abundance in the Glenwood district, Hawaii, and is

FIGURE 42.—*Sacciolepis contracta*

found on all the other islands. It is an annual, erect from a spreading base, and 1 to 2 feet tall. It seeds profusely, spreads rapidly, and is very persistent. On the poor, soggy soils of the Glenwood district it crowds out Hilo grass and sedges. Cattle relish Glenwood grass and fatten on it. Its excellent qualities are not generally appreciated.

No. 43. SETARIA LUTESCENS, SETARIA GLAUCA, CHAETOCHLOA LUTESCENS *(6, p. 210)*

Common name: Yellow foxtail

Setaria lutescens was originally described from Europe (*6, p. 207*). The seed is said to have been brought into Hawaii in hay from Cali-

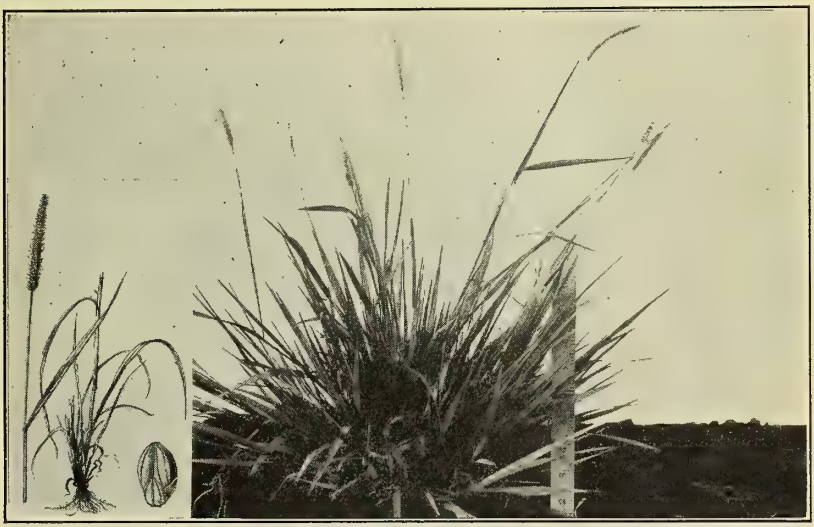

FIGURE 43.—*Setaria lutescens*

fornia. It is an annual, semierect, and usually not over 2 feet tall. It is regarded as one of the most undesirable of Hawaiian grasses. Cattle do not relish it and the hairy heads are said to give them throat trouble. It forces out most of the other grasses and grows as almost a solid stand in certain areas on Kauai.

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No. 44. SETARIA VERTICILLATA, CHAETOCHLOA VERTICILLATA *(6, p. 204)*

Common name: Bristly foxtail

Bristly foxtail was originally described from the Old World (*4, p. 178–180*). It is an annual, erect or semierect, and attains a height of 1

FIGURE 44.—*Setaria verticillata*

to 3 feet. It seeds profusely and is seasonal in growth, springing up after a heavy rain. Unlike yellow foxtail, bristly foxtail is regarded as a good feed, both for pasture and as a soilage crop. It is considered equal or superior to Para grass for milk production.

No. 45. SORGHUM VULGARE SUDANENSE, HOLCUS SORGHUM SUDANENSIS, ANDROPOGON SORGHUM SUDANENSIS *(10, p. 37)*

Common name: Sudan grass

Sudan grass (*10, p. 36*) is cultivated in the warmer regions of both hemispheres. It is annual or perennial and 3 to 7 feet tall. Although making its best growth at lower levels it will grow at relatively high altitudes. It is as drought resistant as the best varieties of sorghums. In regions of low rainfall and high temperature its carrying capacity

FIGURE 45.—*Sorghum vulgare sudanense*

during the summer is said to exceed that of any other grass or legume. It is also well adapted to irrigated regions. It is valuable as cut feed and also as pasturage if rested at intervals. The grass recovers rapidly after having been cut and produces heavily throughout the year. Sudan grass resembles Johnson grass (*Sorghum halepense*) in appearance, but has broader and more numerous leaves and no underground stems. So far as is known, Johnson grass is not used in Hawaii either for pasture or for cut feed, but grows along the roadsides in many places. Although about equal in value to Sudan grass, Johnson grass is not recommended because of its underground stems, which make its eradication from cultivated fields difficult.

No. 46. SPOROBOLUS BERTEROANUS

Common name: Rattail grass

Rattail grass, originally described from Australia (*6, p. 157–159*), is an erect, tufted perennial, 2 to 3 feet tall. It is found growing on a considerable area of pasture land over the Territory of Hawaii.

FIGURE 46.—*Sporobolus berteroanus*

Rattail grass is generally regarded as low in feeding value, although in certain parts of Kona and Maui the fresh growth is used in fattening. It serves as a maintenance grass in dry weather, and will grow on lands failing to support better grasses. A smaller species, *S. diander*, has a branched, panicle-like seed head and fine, narrow leaves. It has medium feeding value.

No. 47. STENOTAPHRUM SECUNDATUM *(6, p. 176)*, S. AMERICANUM
Common names: St. Augustine grass, buffalo grass

St. Augustine grass is a creeping perennial 4 to 12 inches high, and in Hawaii grows well in shaded places where other grasses die. Under

FIGURE 47.—*Stenotaphrum secundatum*

moist conditions at low altitudes it grows rapidly and furnishes large amounts of feed. The grass is not generally regarded as having high palatability, although in Kona, Hawaii, cattle are said to fatten on it. St. Augustine grass is also used for lawns in locations too shaded for Bermuda grass or manienie.

No. 48. TRICHACHNE INSULARIS, VALOTA INSULARIS *(6, p. 172)*

Common names: Silk grass, sour grass

Sour grass, originally described from Jamaica (*6, p. 170*), is distributed over the Tropics and sub-Tropics of the Western Hemisphere.

FIGURE 48.—*Trichachne insularis*

This perennial is rather coarse, tufted, and 4 feet high or more. It is decidedly unpalatable to all kinds of stock, and is regarded as a weed in Central America. In Hawaii it is one of the most obnoxious grasses. It seeds heavily and spreads rapidly. At present, it is largely restricted to Oahu.

No. 49. TRICHOLAENA ROSEA *(6, p. 206)*

Common names: Natal grass, Natal redtop

Natal grass, a native of Africa (*6, p. 204, 205*), was reported in Hawaii as early as 1894, and is now scattered over all the islands. It is an erect perennial attaining a height of 3 feet or more, and spreads

FIGURE 49.—*Tricholaena rosea*

by means of underground stems and by seeds. In Hawaii it is valuable for the dry lands. It will likewise grow on stony land in dry places where few other grasses survive. Natal grass withstands pasturing if it is allowed to rest and reseed itself at intervals. It is said to recover quickly after drought. The grass is tender and palatable when young but wiry and tough when old. Because of its abundant seeding it is regarded as a pest on sugar plantations. It can be propagated easily by scattering the dried mature grass containing the seed.

COMPOSITION

Results of recent investigations have shown that analysis of a grass is of little value unless attention is paid to the stage of maturity at which it is cut and to climatic conditions prevailing during its growth. Grass progresses from a succulent stage consisting entirely of leaves and sheaths, to a mature stage in which stems predominate and bear partly dried leaves or none at all. During this period the plant changes from an easily digested, concentrate feed of high protein content, to one high in fiber and low in protein and in digestibility. Table 1, compiled from data collected by the Waite Institute (*3, p. 23*), illustrates the effect of the maturity of a plant on its protein and fiber content.

TABLE 1.—*Percentages of protein and crude fiber in dry weight of grass, as affected by cutting the grass*[1] *at different intervals*

Plat No.	Interval between cuttings	Protein	Crude fiber	Plat No.	Interval between cuttings	Protein	Crude fiber
	Weeks	*Per cent*	*Per cent*		*Weeks*	*Per cent*	*Per cent*
1	2	14.56	18.84	4	10	8.56	25.18
2	4	14.00	23.43	5	(2)	5.00	29.93
3	7	10.56	25.33				

[1] The herbage—a mixture of perennial and annual grasses, legumes, and miscellaneous species—was cut from adjoining plats.
[2] Plants were mature. End of the growing season.

Table 2 gives information about each grass analyzed, where it was grown, and the stage of maturity at which it was cut. In most instances analyses were made of mature grasses only, all the leaves being green and the seed in the dough stage, approximating the condition in a rested paddock at the time when the cattle are turned in.

TABLE 2.—*Composition of Hawaiian grasses*

[Expressed in percentages of dry matter]

Grass No.	Kind of grass	Source	Description of sample	Crude protein (N × 6.25)	Fat (ether extract)	Carbohydrates		Ash	Lime (CaO)	Phosphoric acid (P_2O_5)	Nutritive ratio 1 to—
						Nitrogen-free extract	Crude fiber				
1	Redtop	Island of Hawaii, Puu Oo ranch; elevation 6,500 feet.	In full seed; 3 feet high	6.85	1.19	54.09	34.40	3.47	0.36	0.26	8.3
2	Angleton grass	Pensacola Street station, Honolulu	In full seed; 2½ feet high; stemmy; all leaves green.	3.83	.99	41.20	37.16	16.82	.25	.44	11.3
3	Wilder grass	do	do	4.45	.90	42.05	34.30	18.30	.34	.51	9.9
4	Silver beardgrass	do	Fully mature; stemmy; leaves green and most of seed gone.	7.42	1.31	45.67	31.40	14.20	.30	1.07	6.5
5	Australian bluegrass	do	In full seed; dough stage; 18 inches high; stemmy; leaves green.	4.50	2.24	42.31	36.20	14.75	.24	.70	10.5
5	do	Hawaiian Islands	Not recorded	6.31	2.00	41.20	43.22	7.27			7.2
6	Sweet vernal grass	Puu Oo ranch, Hawaii	Fully mature; stemmy; leaves mostly dry	4.03	1.24	52.69	39.60	2.44	.25	.22	13.8
7	Tall oatgrass	do	Fully mature; 3 feet high; leaves green	7.23	1.89	46.88	38.60	5.40	.30	.50	7.1
8	Carpet grass	Pensacola Street station, Honolulu	Equal proportion of stems and leaves; 4 to 5 inches of growing tips.	6.07	.85	54.48	26.30	12.30	.34	.37	9.3
8	do	Waimea, Hawaii; grass plats, elevation 3,000 feet.	do	5.33	1.04	54.99	30.20	8.44	.32	.60	10.7
9	Rescue grass	Eastertide paddock, Parker ranch, Hawaii; elevation 5,000 feet.	In full seed; succulent; 4 feet high; grown in shade.	15.05	1.94	32.60	33.51	16.90	1.44	.88	2.5
9	do	Parker ranch, Waikii, Hawaii; elevation 4,500 feet.	In full seed; dough stage; 2½ feet tall; succulent	17.20	1.98	39.52	31.50	9.80	.66	.92	2.6
9	do	Upper Kapapala ranch, elevation 4,000 feet.	In full seed; 2½ feet tall; succulent; vigorous	8.80	1.69	49.31	30.60	9.60	.41	.64	6.0
10	Rhodes grass	Grass plats, Waimea, Hawaii	Fresh, green; 12 inches high; no seed stems	11.10	1.93	40.97	32.60	13.40	.70	.73	4.1
10	do	Pensacola Street station, Honolulu	In full seed; dough stage; 3 feet tall; all green leaves.	4.80	1.51	43.79	34.40	15.50	.39	1.07	9.8
12	*Chloris radiata*	Hind-Clarke dairy, Oahu	In full seed; succulent; leaves green; woody stems discarded.	11.60	2.56	41.64	29.90	14.30	.36	1.31	4.1
13	Bermuda grass	Hawaiian Islands [1]	Not recorded	6.86	.58	59.84	22.93	9.79	.25	.89	8.9
13	do	Not recorded [2]	do	10.69	2.13	53.75	23.52	9.91			5.5
14	Orchard grass	Puu Oo ranch, Hawaii	In full seed; stemmy; leaves green; 1½ feet tall	6.73	3.63	43.77	40.20	5.67	.27	.29	7.7
14	do	Not recorded [2]	Not recorded	9.53	3.24	53.76	25.40	8.07			6.4
15	*Digitaria pruriens*	Waipahoehoe, Keeau district, Hawaii; elevation 300 feet.	In full seed; leaves green; stems succulent	14.50	2.16	44.04	28.00	11.30	.82	.46	3.4
16	*Digitaria sanguinalis*	do	do	13.90	2.26	41.89	30.50	11.45	.64	.39	3.4

[1] (*11, p. 16*).

[2] (*14, p. 125–128*).

TABLE 2.—*Composition of Hawaiian grasses*—Continued

Grass No.	Kind of grass	Source	Description of sample	Crude protein (N × 6.25)	Fat (ether extract)	Carbohydrates		Ash	Lime (CaO)	Phosphoric acid (P_2O_5)	Nutritive ratio 1 to—
						Nitrogen-free extract	Crude fiber				
16	*Digitaria sanguinalis*	Hawaiian Islands [1]	Not recorded	10.96	1.28	48.95	26.55	12.26	.14	.73	4.7
17	*Digitaria violascens*	Waipahoehoe, Keeau district, Hawaii; elevation 300 feet.	In full seed; leaves green; stems succulent	10.15	2.35	51.15	29.00	7.35	.46	.25	5.6
18	Crowfoot	Hawaiian Islands [1]	Not recorded	8.41	4.58	41.25	35.51	10.25	.17	1.03	6.1
19	Brome fescue	Parker ranch, second Homestead series; Hawaii; elevation 3,000 feet.	Plant overmature and leaves partly dry	9.15	1.85	47.36	35.10	6.54	.30	.46	5.6
20	Meadow fescue	Parker ranch grass plats, Waimea, Hawaii.	In full seed; leaves green; 2½ feet tall	8.15	2.76	44.99	33.80	10.30	.70	.80	6.3
21	Pili grass	Parker ranch on road to Kawaihae, Hawaii; elevation 1,500 feet.	Completely dry; arid condition; 3 feet tall; stemmy.	2.80	1.63	49.27	35.40	10.90	.35	.17	19.0
21	do	Hawaiian Islands [1]	Not recorded	4.84	1.38	49.79	32.53	11.46	.47	.73	10.9
22	Velvet grass	Upper Kapapala ranch, Hawaii	Half grown; succulent leaves; no stems	14.35	3.08	40.27	29.40	12.90	.48	.74	3.3
22	do	Puu Oo ranch, Hawaii	In full seed; vigorous; succulent	6.88	1.70	48.89	34.00	8.53	.42	.41	7.7
23	Mexican grass	Parker ranch grass plats, Waimea, Hawaii.	Leaves and sheaths only; 18 inches tall	5.58	1.57	49.65	31.40	11.80	.70	1.42	9.5
24	Italian ryegrass	Parker ranch, Waikii, Hawaii	In full seed; dough stage; leaves green	10.69	1.65	44.24	32.50	10.92	.60	.73	4.5
24	do	Puu Oo ranch, Hawaii; elevation 6,500 feet.	In full seed; young; succulent	8.45	1.67	51.08	33.00	5.80	.39	.50	6.5
24	do	Not recorded [2]	Not recorded	14.49	2.32	51.73	20.44	11.02			3.9
25	Molasses grass	Pensacola Street station, Honolulu	Tips 4 inches long; very little stem; dry	6.15	2.12	53.43	29.70	8.60	.32	.68	9.5
26	Meadow rice grass	H. Greenwell ranch, Kona, Hawaii; elevation 3,500 feet.		8.93	1.46	54.09	27.80	7.72	.82	.17	6.4
27	*Oryzopsis miliacea*	Pensacola Street station, Honolulu	In full seed; stemmy; leaves green; 3½ feet tall	6.58	1.39	48.33	32.90	10.80	.36	1.28	7.8
28	Guinea grass	do	Fully mature; leaves green	5.80	1.38	43.42	32.30	17.10	.55	.98	8.0
28	do	Hawaiian Islands [1]	Not recorded	5.52	.87	54.59	28.17	10.85	.54	.45	10.2
29	Para grass	University of Hawaii, Honolulu	6 inches of growing tips; very little stem	8.88	1.02	45.30	30.90	13.90	.48	1.29	5.4
30	Hilo grass	Hawaiian Islands [1]	Not recorded	4.71	2.30	54.39	29.93	8.67	.26	.46	12.7
31	Dallis grass	do [1]	do	11.23	2.44	42.21	34.48	9.64	.42	.68	4.2
31	do	Not recorded [2]	do	6.13	2.21	58.42	24.75	8.49			10.3
32	Panama paspalum	Makiki Valley, Oahu	In full seed; leaves green and succulent	8.34	2.02	46.34	29.30	14.00	1.89	.98	6.1
33	Bahia grass	Parker ranch grass plats, Waimea, Hawaii.	Fully mature; no seed stems	5.40	1.41	50.94	31.65	10.60	.82	.39	10.0
34	Rice grass	Hawaiian Islands [1]	Not recorded	4.96	1.07	53.48	31.84	8.65	.39	.23	11.2
35	Vasey grass	Puu Oo ranch, Hawaii	In full seed; 3 feet high; leaves green; stems woody.	3.87	1.38	47.55	39.70	7.50	.24	.41	13.1
36	Kikuyu	University of Hawaii, Honolulu	Growing tips; little stem	6.18	1.10	51.12	31.30	10.30	.60	1.08	8.7
36	do	do	do	10.85	2.74	48.49	27.30	10.62	.43	.97	5.0

36	do	Kooloa ranch, Oahu; elevation 100 feet.	Growing tips; succulent	11.35	2.04	47.98	29.00	9.63	.31	.59	4.6
36	do	do	Growing tips; succulent; partly dry	10.45	2.48	52.22	25.50	9.35	.49	1.50	5.5
36	do	Keeau region, Waipahoehoe, Hawaii; elevation 300 feet.	Growing tips; young and succulent	18.50	2.22	40.21	30.30	8.77	.53	.36	2.4
36	do	New South Wales [3]	Not recorded	13.60	1.73	48.24	26.70	9.73			3.8
37	*Pennisetum complanatum.*	Grass plats, Waimea, Hawaii	In full seed; 3 feet high; stemmy; leaves green	4.37	1.36	45.31	39.30	9.66	.36	.57	11.0
37	do	Pensacola Street station, Honolulu	In full seed; 18 inches high; stemmy; leaves green.	4.58	1.51	41.31	36.50	16.10	.20	1.23	9.8
38	Napier grass	University of Hawaii, Honolulu	Immature; 3 feet high; ends growing; little stem.	8.70	2.12	44.18	29.90	15.10	.31	1.46	5.6
38	do	do	Mature; 8 feet high; growing ends; little stem	6.57	2.08	47.85	31.50	12.00	.38	.77	8.0
	Merker grass [4]	Pensacola Street station, Honolulu	Immature; 3 feet high; ends growing only	9.27	2.24	46.84	27.35	14.30	.36	1.25	5.6
	do [4]	University of Hawaii, Honolulu	Mature; 8 feet high; ends growing only	8.50	1.99	48.16	29.60	11.75	.52	.73	6.2
39	*Phalaris tuberosa*	Grass plats, Waimea, Hawaii	Mature; green leaves only; no stems	8.45	3.48	39.32	33.50	15.25	.59	.86	5.6
40	Kentucky bluegrass	Parker ranch, Eastertide Paddock, Hawaii.	Mature; succulent; grown in shade; not grazed; leaves only.	16.55	2.46	33.59	31.60	15.80	1.00	.95	2.4
40	do	Puu Oo ranch, Hawaii	Mature; succulent; grown in shade; not grazed; leaves only.	12.45	1.58	44.80	34.50	6.67	.29	.49	2.4
40	do	Not recorded [2]	Not recorded	10.44	3.41	55.32	23.10	7.73			6.0
41	Pilipiliula	Hawaii [1]		5.02	.61	61.15	27.56	5.66	.03	.61	12.5
42	Glenwood grass	Glenwood district, Hawaii; elevation 2,500 feet.	Full seed; 12 inches high; leaves green	7.96	2.70	45.84	32.30	11.20	.33	.63	6.5
43	Yellow foxtail	Not recorded [2]	Not recorded	9.04	2.66	55.28	25.75	7.27			6.8
44	Bristly foxtail	Hawaiian Islands [5]	do	9.82	1.31	42.14	35.09	11.64			4.6
45	Sudan grass	Hind-Clarke dairy, Oahu	Vigorous; succulent; 3 feet high; stems tender	16.18	2.43	38.09	29.55	13.75	.60	.92	2.7
45	do	Hawaiian Islands [5]	Not recorded	8.44	1.89	43.06	36.99	9.62			5.6
45	do	Not recorded [6]	do	8.96	1.80	51.62	29.68	7.94			6.2
	Johnson grass [7]	do [5]	do	8.01	2.33	51.16	31.70	6.80			7.0
46	Rattail grass	Puu Oo ranch, Hawaii	In full seed; leaves green	6.40	1.32	50.41	37.40	4.47	.35	.35	8.3
47	St. Augustine grass	University of Hawaii, Honolulu	6 inches of growing tips; little stem; leaves green.	10.10	2.40	43.40	30.80	13.30	.62	.93	4.8
47	do	Hawaiian Islands [1]	Not recorded	4.12	1.09	62.33	28.23	4.23	.17	.65	15.7
49	Natal grass	Parker ranch, Keamoku region, Hawaii; elevation 2,500 feet.	Nearly dry; 2½ feet tall; stemmy; arid conditions.	7.05	1.41	45.34	34.50	11.70	.54	.54	6.9
49	do	Hawaiian Islands [5]	Not recorded	4.69	1.99	42.09	41.99	9.24			9.9

[1] *(11, p. 16).*
[2] *(14, p. 125–128).*
[3] *(1, p. 100).*
[4] A form of elephant grass.
[5] *(8, p. 11).*
[6] *(15, p. 20).*
[7] See under grass No. 45, p. 47.

LIST OF GRASSES, BY SCIENTIFIC NAME

Scientific name	Common name	Page
Agrostis alba	Redtop	3
Andropogon aciculatus	Pilipiliula	43
Andropogon annulatus	Angleton grass	4
Andropogon contortus	Pili grass, twisted beardgrass	23
Andropogon nodosus	Wilder grass	5
Andropogon saccharoides	Silver beardgrass, feather bluestem, fuzzy top	6
Andropogon sericeus	Australian bluegrass, Queensland bluegrass	7
Andropogon sorghum sudanensis	Sudan grass	47
Anthoxanthum odoratum	Sweet vernal grass	8
Arrhenatherum elatius	Tall oatgrass	9
Axonopus compressus	Carpet grass	10
Bromus unioloides	Rescue grass, bromegrass, wild oatgrass	11
Capriola dactylon	Bermuda grass, manienie	15
Chaetochloa lutescens	Yellow foxtail	45
Chaetochloa verticillata	Bristly foxtail	46
Chloris barbata		13
Chloris gayana	Rhodes grass	12
Chloris inflata		13
Chloris paraguayensis		13
Chloris radiata		14
Chrysopogon aciculatus	Pilipiliula	43
Cynodon dactylon	Bermuda grass, manienie	15
Dactylis glomerata	Orchard grass, cocksfoot	16
Digitaria chinensis	Crabgrass, kukaipuaa	19
Digitaria pruriens	do	17
Digitaria sanguinalis	do	18
Digitaria violascens	do	19
Eleusine indica	Crowfoot, goose grass, yard grass	20
Eragrostis atropioides	Pili grass	23
Festuca dertonensis	Brome fescue	21
Festuca elatior	Meadow fescue, tall fescue	22
Heteropogon contortus	Pili grass, twisted beardgrass	23
Holcus lanatus	Velvet grass, mesquite, Yorkshire fog	24
Holcus sorghum sudanensis	Sudan grass	47
Ixophorus unisetus	Mexican grass	25
Lolium multiflorum	Italian ryegrass	26
Lolium perenne	English ryegrass	26
Lolium temulentum	Darnel	26
Melinis minutiflora	Molasses grass, Brazilian stink grass	27
Microlaena stipoides	Meadow rice grass, puu lehua	28
Notholcus lanatus	Velvet grass, mesquite, Yorkshire fog	24
Oryzopsis miliacea		29
Panicum barbinode	Para grass, panic grass	31
Panicum maximum	Guinea grass	30
Panicum purpurascens	Para grass, panic grass	31
Paspalum compressum	Carpet grass	10
Paspalum conjugatum	Hilo grass	32
Paspalum dilatatum	Dallis grass, Australian water grass, paspalum grass	33
Paspalum fimbriatum	Panama paspalum	34
Paspalum larranagai	Vasey grass	37
Paspalum notatum	Bahia grass	35
Paspalum orbiculare	Rice grass	36
Paspalum urvillei	Vasey grass	37
Pennisetum clandestinum	Kikuyu	38
Pennisetum complanatum		39
Pennisetum purpureum	Napier grass, elephant grass, Merker grass	40
Pennisetum setosum		39
Phalaris bulbosa		41
Phalaris stenoptera	Harding grass, Peruvian winter grass	41
Phalaris tuberosa		41
Poa annua		42
Poa pratensis	Kentucky bluegrass, bluegrass	42
Rhaphis aciculata	Pilipiliula	43
Sacciolepis contracta	Glenwood grass	44
Setaria glauca	Yellow foxtail	45
Setaria lutescens	do	45
Setaria verticillata	Bristly foxtail	46
Sorghum halepense	Johnson grass	47
Sorghum vulgare sudanense	Sudan grass	47
Sporobolus berteroanus	Rattail grass	48
Sporobolus diander		48
Stenotaphrum americanum	St. Augustine grass, buffalo grass	49
Stenotaphrum secundatum	do	49
Syntherisma chinensis	Crabgrass, kukaipuaa	19
Syntherisma helleri	do	19
Syntherisma pruriens	do	17
Syntherisma sanguinalis	do	18
Trichachne insularis	Silk grass, sour grass	50
Tricholaena rosea	Natal grass; Natal redtop	51
Valota insularis	Silk grass, sour grass	50

LIST OF GRASSES, BY COMMON NAME

Common name	Scientific name	Page
Angleton grass	*Andropogon annulatus*	4
Australian bluegrass	*Andropogon sericeus*	7
Australian water grass	*Paspalum dilatatum*	33
Bahia grass	*Paspalum notatum*	35
Bermuda grass	*Capriola dactylon; Cynodon dactylon*	15
Bluegrass	*Poa pratensis*	42
Brazilian stink grass	*Melinis minutiflora*	27
Bristly foxtail	*Chaetochloa verticillata; Setaria verticillata*	46
Bromegrass	*Bromus unioloides*	11
Brome fescue	*Festuca dertonensis*	21
Buffalo grass	*Stenotaphrum americanum; S. secundatum*	49
Carpet grass	*Axonopus compressus; Paspalum compressum*	10
Cocksfoot	*Dactylis glomerata*	16
Crabgrass	*Digitaria chinensis; D. pruriens; D. sanguinalis; D. violascens; Syntherisma chinensis; S. helleri; S. pruriens; S. sanguinalis*	17, 18, 19
Crowfoot	*Eleusine indica*	20
Darnel	*Lolium temulentum*	26
Dallis grass	*Paspalum dilatatum*	33
Elephant grass	*Pennisetum purpureum*	40
English ryegrass	*Lolium perenne*	26
Feather bluestem	*Andropogon saccharoides*	6
Fuzzy top	do	6
Glenwood grass	*Sacciolepis contracta*	44
Goose grass	*Eleusine indica*	20
Guinea grass	*Panicum maximum*	30
Harding grass	*Phalaris stenoptera*	41
Hilo grass	*Paspalum conjugatum*	32
Italian ryegrass	*Lolium multiflorum*	26
Johnson grass	*Sorghum halepense*	47
Kentucky bluegrass	*Poa pratensis*	42
Kikuyu	*Pennisetum clandestinum*	38
Kukaipuaa	*Digitaria chinensis; D. pruriens; D. sanguinalis; D. violascens; Syntherisma chinensis; S. helleri; S. pruriens; S. sanguinalis*	17, 18, 19
Manienie	*Capriola dactylon; Cynodon dactylon*	15
Meadow fescue	*Festuca elatior*	22
Meadow rice grass	*Microlaena stipoides*	28
Merker grass	*Pennisetum purpureum*	40
Mesquite	*Holcus lanatus; Notholcus lanatus*	24
Mexican grass	*Ixophorus unisetus*	25
Molasses grass	*Melinis minutiflora*	27
Napier grass	*Pennisetum purpureum*	40
Natal grass	*Tricholaena rosea*	51
Natal redtop	do	51
Orchard grass	*Dactylis glomerata*	16
Panama paspalum	*Paspalum fimbriatum*	34
Panic grass	*Panicum barbinode; P. purpurascens*	31
Para grass	do	31
Paspalum grass	*Paspalum dilatatum*	33
Peruvian winter grass	*Phalaris stenoptera*	41
Pili grass	*Andropogon contortus; Eragrostis atropioides; Heteropogon contortus*	23
Pilipiliula	*Andropogon aciculatus; Chrysopogon aciculatus; Rhaphis aciculata*	43
Puu lehua grass	*Microlaena stipoides*	28
Queensland bluegrass	*Andropogon sericeus*	7
Rattail grass	*Sporobolus berteroanus*	48
Redtop	*Agrostis alba*	3
Rescue grass	*Bromus unioloides*	11
Rhodes grass	*Chloris gayana*	12
Rice grass	*Paspalum orbiculare*	36
Ryegrass	*Lolium multiflorum*	26
Silk grass	*Trichachne insularis; Valota insularis*	50
Silver beardgrass	*Andropogon saccharoides*	6
Sour grass	*Trichachne insularis; Valota insularis*	50
St. Augustine grass	*Stenotaphrum americanum; S. secundatum*	49
Sudan grass	*Andropogon sorghum sudanensis; Holcus sorghum sudanensis; Sorghum vulgare sudanense*	47
Sweet vernal grass	*Anthoxanthum odoratum*	8
Tall fescue	*Festuca elatior*	22
Tall oatgrass	*Arrhenatherum elatius*	9
Twisted beardgrass	*Andropogon contortus; Heteropogon contortus*	23
Vasey grass	*Paspalum larranagai; P. urvillei*	37
Velvet grass	*Holcus lanatus; Notholcus lanatus*	24
Wild oatgrass	*Bromus unioloides*	11
Wilder grass	*Andropogon nodosus*	5
Yard grass	*Eleusine indica*	20
Yellow foxtail	*Chaetochloa lutescens; Setaria glauca; S. lutescens*	45
Yorkshire fog	*Holcus lanatus; Notholcus lanatus*	24

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